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Can Implied Isolation and Novelty Be Responsible for the Effect of 'Adaptive Memory'?

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CAN IMPLIED ISOLATION AND NOVELTY BE RESPONSIBLE FOR THE EFFECT OF 'ADAPTIVE MEMORY'?

by

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Abstract

Adaptive memory is "the idea that [our] memory systems might have evolved to help us remember fitness-relevant information—specifically, information relevant to survival" (Nairne, Thompson, & Pandeirada, 2007, p. 263). Nairne et al. found that processing words in terms of survival relevance yielded the best memory retention compared to other deep processing conditions. The purpose of the present research was to investigate whether factors including a feeling of isolation or novelty could explain the adaptive memory advantage observed in previous adaptive memory research. In two incidental learning experiments, participants rated word relevance in one of four conditions: grasslands survival, space mission, alien abduction, or moving. In Experiment 1, participants rated 32 unrelated words. In Experiment 2, participants rated 60 words from six DRM lists. In Experiment 1 there was one incidental free recall test whereas in Experiment 2 three successive free recall tests were employed. As hypothesized, results from Experiment 1 indicated that the grasslands survival scenario, space mission, and alien conditions had similar rates in recall. The typical adaptive memory effect was also found in which participants in the grasslands survival scenario condition had significantly higher recall compared to participants who received the moving scenario condition. Experiment 2 found that all of the conditions did not significantly differ from each in terms of true or false recall. Across both experiments, the grasslands survival, space mission, and alien abduction scenarios were rated similarly in terms of isolation and novelty. These findings suggest that novelty and isolation can be contributing factors in

the memory advantage observed with the grasslands survival scenario in previous adaptive memory studies.

Can Implied Isolation and Novelty Be Responsible For the Effect of 'Adaptive Memory'?

Human memory has been likened to a spatial metaphor (Roediger, 1980). This metaphor compares human memory to a library in which the books are memories and removing a book from a shelf and reading it is like retrieving a memory. There has been a plethora of research conducted on true memory (for a comprehensive review, see Roediger, 2008). However, memories are not created equal. Memory distortions and false memories happen frequently in real life situations and laboratory situations. An example of memory distortion occurs in eyewitness testimonies. Jurors assume that eyewitnesses are very accurate in their testimonies, but it has been shown that eyewitnesses can be very inaccurate (see Brainerd & Reyna, 2005). These memory distortions in eyewitness testimonies arise from criminal-investigation interviews, confirmation bias, the misinformation effect, and other factors (Brainerd & Reyna). Criminal-investigation interviews can distort eyewitness testimonies through misleading questions, misinformation and suggestion. One factor that produces memory distortion is confirmation bias which occurs when the investigator knows facts about the case and tries to influence the eyewitness to confirm these facts (Brainerd & Reyna). Confirmation bias and the misinformation effect can decrease the accuracy of eyewitness testimonies through post-event information. The misinformation effect occurs when post-event information can decrease the accuracy for the original event (for a comprehensive review, see Brainerd & Reyna).

Given that memory distortions and false memories happen frequently in everyday life, researchers created a way to study false memories in an experimental setting. For

example, the Deese-Roediger-McDermott (DRM) paradigm causes participants to falsely remember words that were not actually presented to them (Deese, 1959; Roediger & McDermott, 1995). This false memory error occurs when the participants study a list of semantically related words that are associated to a non-presented critical lure. An example of a DRM word list is as follows *bed, rest, awake, tired, dream, wake, snooze, blanket, doze,* and *slumber*, with the critical lure: *sleep*. Participants have a high probability of falsely remembering the critical lure. In the example above, sleep is semantically related to all of the words on the list so participants might falsely remember seeing or learning that word when it was not actually presented.

False memories occur quite frequently in the context of the DRM paradigm. For example, participants were presented with six DRM lists and after each list was presented, they were given a free recall test (Roediger & McDermott, 1995). After all of the tests, the participants completed a recognition test. According to the free recall tests, the probability of recalling a non-presented critical lure was .40 when six DRM lists were presented. On the recognition test, the probability of recognizing a non-presented critical lure was .84 which was close to the probability of recognition of .86 in the studied items. False recognition and recall might occur because the ease of producing an event in memory, such as thinking you heard the speaker present the word in the list, is enhanced by having words that were semantically related on the list (Roediger & McDermott).

One factor that affects true and false recall is the effect of repeated testing, known as hypermnesia. The hypermnesic effect is when performance improves with repeated recall testing (Erdelyi & Becker, 1974). This means that giving successive recall tests increases recall for items over time. However, the increase in recall can be seen as a

double-edged sword—as true recall increases, the possibility for false memories increases as well (Roediger, McDermott, & Goff, 1997).

Previous research has found that repeated free recall increased the amount of false memories on each successive recall test (Payne, Elie, Blackwell, & Neuschatz, 1996). The participants were presented with six DRM lists and then completed three successive seven minute free-recall tests. The finding was that true and false recall increased across repeated recall tests. The researchers concluded that the increase in false memories can be attributed to how we store memories during encoding. According to the fuzzy trace theory, encoding involves representing information in both verbatim and gist formats, with verbatim and gist traces being formed independently of one another (Brainerd & Reyna, 1990). Remembering material is then a matter of accessing verbatim information or the gist of things. DRM lists are thematic in nature, therefore there tends to be a premium placed on gist processing. Because the critical lure is repeatedly cued during encoding, the likelihood of retrieving the critical lure at testing is very high. When people rely on the gist of things, they believe a word was presented to them when it is very similar in a semantic sense to the words presented in a thematic list. Therefore, remembering the gist of material produces false memory on an initial test, and tends to perpetuate these illusory memories over tests, and thus can elicit a hypermnesic effect.

Another factor that affects true and false recall is levels of processing. Past research has also investigated true and false memory occurrence when depth of processing is manipulated (Toglia, Neuschatz, & Goodwin, 1999). Deeper levels of processing increase the memorability for a stimulus (Craik & Lockhart, 1972). There are multiple levels of processing types that vary in the degree of depth of encoding such as

shallow graphemic processing, intermediate phonemic processing, and deep semantic processing (Craik & Lockhart, 1972; Craik & Tulving, 1975). Shallow graphemic processing involves a physical analysis of a stimulus such as structural properties of a word. An example of shallow graphemic processing is deciding if a word contained the letter “a”. Intermediate phonemic processing involves attending to the sound of a stimulus. An example of intermediate phonemic processing is deciding if a word rhymes with a target word, one presented in the study. Deep semantic processing involves analyzing stimuli in terms of meaningful content which causes more elaboration for that stimulus. Some examples of deep semantic processing include deciding if a word fits properly in the blank within a sentence or rating words in terms of pleasantness. In the Toglia et al. (1999) study, the participants were presented with word lists known to create false memories in either a semantic (deep processing) encoding condition or a nonsemantic (shallow processing) condition. The semantic encoding condition had participants rate words in terms of pleasantness whereas the nonsemantic encoding condition had participants decide if the words contained the letter “a”. The results indicated that the semantic encoding condition elicited higher true and false memory recall compared to the nonsemantic encoding condition. Another example of a deep processing condition is the self-reference effect which has been shown to enhance memory retention (Rogers, Kuiper, & Kirker, 1977). The self-reference effect is when memory retention increases when relating information to one’s self. In past research, it was found that participants who rated adjectives in the self-reference condition recalled significantly more words compared to the graphemic (shallow processing), phonemic (intermediate processing), and even the semantic (deep processing) conditions.

There has also been a plethora of research conducted on true and false memory. Researchers now assume that memory has an adaptive component involved (e.g., Nairne, Thompson, & Pandeirada, 2007). It is believed that humans have adapted to solve specific problems that were encountered in our ancestral past (Tooby & Cosmides, 2005, 1992). Researchers have found that humans might have specialized survival mechanisms that can help us detect predators (Barrett, 2005) or cheaters (Cosmides, 1989). Due to these possible survival mechanisms, it is possible that our memory systems have evolved to help us survive and out-compete others (Nairne et al., 2007). This hypothesis has created a new area in cognitive psychology interested in how we remember survival-relevant information.

Adaptive Memory

Adaptive memory is "the idea that [our] memory systems might have evolved to help us remember fitness-relevant information—specifically, information relevant to survival" (Nairne et al., 2007, p. 263). It is characterized by recalling more words when relating the words to survival relevance. The researchers believed that adaptations carried over from our ancestral environment contributed to our enhanced memory for information related to our survival. The researchers expected that survival processing would induce a deeper level of processing and would enhance retention.

In their first adaptive memory study, participants rated 30 unrelated words in terms of relevance according to three conditions: grasslands survival, moving, and pleasantness (Nairne et al., 2007). In the grasslands survival condition, participants imagined that they were alone in the grasslands of a foreign land and that they had to find supplies to survive and protect themselves from predators. The first control condition was

a moving condition in which participants were asked to rate how relevant the words were to a situation where they would be moving to a foreign country. The other control condition was a pleasantness condition in which participants rated the words in terms of pleasantness. The participants rated the words on a 5-point scale, with 1 indicating totally irrelevant (or unpleasant) and 5 indicating extremely relevant (or pleasant). These conditions were used as controls because it was predicted that they would induce levels of processing similar in depth to the grasslands survival condition.

After the word rating portion of the study, the participants were given a short distractor task of digit recall and then an incidental free-recall memory test. Participants who rated the words for survival-relevance had a significantly higher mean proportion correct than both of the control conditions. These authors argued that making a survival decision is more difficult or effortful than the moving or pleasantness decisions. They came to this conclusion because of the slower response times in the word rating task for the grasslands survival condition. They concluded that the memory advantage in the grasslands survival condition was due to our memory systems being more likely to remember information that is relevant to our survival (Nairne et al., 2007).

To further explore the effect of adaptive memory, an incidental free-recall test and a recognition test were implemented in an attempt to replicate the survival memory advantage (Nairne et al., 2007). In both of these experiments, Nairne et al. replicated the findings from the first experiment. In the last experiment, the grasslands survival condition was compared to a self-referent condition in a free-recall within-subject design. The self-referent condition asked participants to rate the words on how easily the word made an important personal experience come to mind. They found a survival memory

advantage in which participants recalled more words when they rated those words in the grasslands survival condition than when they rated those words in the self-referent condition. The self-reference effect results from one of the deepest levels of elaboration known to enhance memory retention (Rogers et al., 1977), so the finding that the grasslands survival condition induces higher memory retention is surprising. Thus, in all four of the experiments conducted, memory rates were highest in the survival grasslands condition, suggesting that there is something special about this type of processing for our memory (Nairne et al.). There is also the possibility that there is something special about the grasslands scenario itself and not necessarily survival processing that could be eliciting the higher memory retention.

Shortly after the first research conducted on adaptive memory, an attempted replication of the findings of Nairne et al. (2007) was conducted to ensure that the survival advantage could be replicated with other materials in other lab settings (Weinstein, Bugg, & Roediger, 2008). In a within-subject design experiment, the participants rated words in all three original scenarios from Nairne et al., and the results replicated the original findings.

In the second experiment, a new scenario was created to better match the grasslands survival content and wording of the ancestral scenario (Weinstein et al., 2008). Moving to a foreign land and trying to survive in the grasslands of a foreign land are very different scenarios and thus might enhance memory differently. The moving scenario does not require survival processing and thus memory retention might differ from that of the grasslands survival condition. This new scenario required participants to imagine that they were lost in a foreign city and needed to find supplies and protect themselves from

attackers. The new modern city survival scenario was similar to the grasslands survival scenario because they both contained a survival situation in which you needed to protect yourself from attackers or predators, respectively. The researchers also manipulated the perspective (first person, third person) for the grasslands survival, city survival, and moving conditions. The researchers argued that the memory advantage for the grasslands survival condition might be due to the self-referent processing involved in processing this scenario from the first-person perspective. They expected that the third-person perspective should weaken the memory advantage seen in grasslands survival processing. As in the previous studies, the grasslands survival condition produced the highest recall, followed by the city and then the moving conditions. The participants who rated the words in terms of the grasslands survival third-person perspective actually performed better than the grasslands survival first-person perspective. Weinstein et al. concluded that the memory advantage observed in the grasslands survival condition could not be accounted for by self-referent processing. It was quite interesting that just changing a couple of words in the grasslands survival scenario to create the modern city survival scenario drastically decreased the memory recall for the latter scenario. This implied that processing words in terms of grasslands survival as opposed to modern survival might explain the differences seen in memory retention.

Another study replicated the findings from Weinstein et al. (2008) in which the memory recall for the grasslands survival condition was significantly higher compared to a modern city survival condition (Nairne & Pandeirada, 2010). To determine if the scenarios were equal on characteristics that could affect memory retention, a new scenario rating-task was implemented after the memory test in which the participants

rated the scenarios along the following dimensions: interest, imagery, emotionality, familiarity, and unusualness. In a within-subjects design, the participants rated the grasslands survival scenario as significantly more unusual than the modern city survival scenario. This indicated that the novelty of the scenario might have been the basis for the increase in the memory recall seen in the grasslands survival condition. Additionally, the modern city survival scenario was rated as significantly more familiar than the grasslands survival scenario. This also indicated that the grasslands survival scenario might have been more novel than the modern city survival scenario. There were no differences in the other dimensions. Interest, imagery, and emotionality are factors that might explain differences in memory recall, but given that there were no differences in these factors the memory advantage is probably not due to these dimensions.

Past research has implemented the DRM paradigm in relation to adaptive memory (Otgaar & Smeets, 2010). When participants rated DRM word lists for relevance in the different scenarios, the participants in the grasslands survival condition had higher true recall and higher false memory rates than the moving or pleasantness conditions. However, the researchers found that the memory advantage disappeared when the accuracy scores were calculated by dividing true memory by true memory plus false memory. It would seem maladaptive to have false memories in relation to fitness-relevant information, but these researchers state that misremembering details might be adaptive in certain circumstances. They give an example of how seeing predator tracks nearby could cause a person to misremember seeing a predator nearby. This person would be less likely to revisit this location in the future and this could be beneficial because this location was dangerous in the first place. In comparison, you could state that falsely

remembering where food resources are located could be very maladaptive for survival. Misremembering food resources could be more detrimental because food is a necessity for survival.

Another study revealed that the grasslands scenario and survival lists were very susceptible to false memories (Howe & Derbish, 2010). The participants were presented with words from three types of lists (neutral, negative, and survival) in either the grasslands survival condition or pleasantness condition. These researchers found that participants in the grasslands survival condition correctly remembered more words than participants in the pleasantness condition. Also, participants in the survival condition had higher false memory rates (critical lures and intrusions) and lower accuracy compared to participants in the pleasantness condition. There was a similar pattern for survival-related lists. Survival lists produced higher correct recognition compared to negative lists. Also, survival lists had higher false memory (critical lures and intrusions) and lower accuracy compared to the other lists. These researchers concluded that adaptive memory appears to be less accurate than suggested by Nairne and his colleagues (Howe & Derbish).

Another study sought to compare the memory advantage seen in survival processing against other well-known conditions that increase memory retention (Nairne, Pandeirada, & Thompson, 2008). Words were rated in terms of relevance in the following conditions: grasslands survival, pleasantness, imagery, self-reference, and generation. In the imagery condition, participants rated the words in terms of the ease of creating mental images. In the generation condition, participants rated the words in terms of pleasantness, but first they had to reverse the first two letters in the word to create the to-be-rated word. In addition, there was an intentional learning condition in which the participants did not

rate words in terms of relevance, but instead were told to intentionally memorize the words. Once again they found that the grasslands survival condition had significantly better recall than the other conditions. This finding indicated there might be something special about survival processing due to the memory advantage even when compared to other conditions known to increase memory retention.

Alternative Explanations for the Adaptive Memory Effect

Other researchers have shown that survival processing may not be as special as the adaptive memory effect suggests. For example, there is the possibility that the superior memory retention in the grasslands survival condition might have been due to the high relevancy rating scores for the information to be remembered (e.g., Butler, Kang, & Roediger, 2009; Kroneisen & Erdfelder, 2011). A replication of Nairne et al. (2007) was conducted, in which a survival advantage was found, but the analysis of the relevancy ratings revealed that words rated as more relevant were more likely to be recalled later (Butler et al., 2009). This implied that the memory advantage seen in the grasslands survival condition could be attributed to the high relevancy ratings. In their next experiment, they compared the grasslands survival condition to a robbery scenario. In this scenario, participants were asked to imagine that they were planning a bank heist and that they needed to find supplies to carry it out. Instead of using unrelated words to rate for relevance, the participants were presented with three lists that consisted of words that were highly relevant to the grasslands survival condition or robbery condition, or were not relevant at all. A mixed-factorial design was implemented in which the scenarios were a between-subjects factor whereas the type of word list (survival, robbery, irrelevant) was a within-subjects factor. The results revealed that the recall was highest

when the words were highly relevant to the condition. In the grasslands survival and robbery conditions, there was higher recall for words in the survival list and the robbery list, respectively. There were no differences between the conditions in recall for words in the irrelevant list. Additionally, a survival advantage was not found when comparing the overall mean proportion correct in the grasslands survival and robbery conditions. This indicated that survival processing might not be so special.

Other researchers concluded that survival processing does not have to be specific to ancestral contexts (Soderstrom & McCabe, 2011). The original grasslands survival scenario, original modern city survival scenario and the pleasantness condition were used for comparison. Additionally, a grasslands-zombie scenario was created in which the word *predators* in the grasslands survival scenario was replaced with the word *zombies*. Another new scenario called the city-zombie scenario changed the word *attackers* in the modern city survival scenario to the word *zombies*. The grasslands-zombie scenario and the city-zombie scenario elicited significantly higher recall compared to the other conditions. Surviving a zombie attack would not have been something that our ancestors would have had to deal with, implying that survival processing does not involve processing in terms of an ancestral context. It is possible that there is a novelty factor involved which could explain the memory advantage seen in the zombie scenarios. It seems plausible that the word *zombie* in the scenario was unexpected and would grab the participant's attention which could in turn elicit higher recall.

Past research has also investigated how a sense of isolation affects memory recall in survival processing (Kostic, McFarlan, & Cleary, 2012). They implemented a within-subjects design modeled after the second experiment in Nairne et al. (2007) in which

participants rated words in terms of relevance to an alone lost at sea scenario, group lost at sea scenario, and pleasantness condition. In another experiment, participants rated words in terms of relevance to a ghost town scenario, city scenario, and pleasantness condition. They found no significant differences in recall among the isolated conditions and group conditions. These researchers concluded that isolation is probably not causing the memory advantage seen in survival processing. It seems noteworthy that they do not compare the original grasslands survival scenario and a group grasslands survival scenario. It would seem logical to compare these two types of grasslands survival scenarios to the other general survival scenarios in order to directly test whether the isolation in the original grasslands survival is attributing to the memory advantage.

These researchers also wanted to see if the adaptive memory advantage was only specific to the ancestral context or if other survival scenarios could induce memory retention (Kostic et al., 2012). They implemented a within-subjects design where half of the participants rated words in terms of relevance to grasslands survival, desert survival, and pleasantness conditions whereas the other half rated words in terms of relevance to jungle survival, space survival, and self-reference conditions. All of the survival conditions had significantly higher recall compared to the pleasantness and self-referent conditions. The survival conditions were not significantly different from each other. This showed that the survival memory advantage does not only apply to the ancestral grasslands survival scenario, but could also apply to survival scenarios in general.

According to alternative explanations for the adaptive memory effect, other factors might explain the memory advantage observed in the grasslands survival scenario. It is possible that the adaptive memory advantage can be attributed to survival in general

and not necessarily just ancestral survival (see Kostic et al., 2012; Soderstrom & McCabe, 2011). There is also a possible confound of implied isolation in the grasslands survival condition. In the grasslands of a foreign land, you are completely alone and left to fend for yourself as opposed to the modern city survival scenario where you are surrounded by people. In the grasslands survival condition you are also cut off from civilization and ways to contact other people (e.g., without a cell phone) whereas in the modern city survival you are not cut off from human contact and can presumably contact someone if needed. A sense of isolation might increase memory retention seen in the grasslands survival scenario. Novelty can also increase the memory retention seen in the grasslands survival scenario because this scenario seems to have a low probability of happening and can be something unusual to think about. For example, in the grasslands-zombie scenario from Soderstrom and McCabe (2011), it seems entirely possible that thinking about zombies attacking you is very novel and would stand out in your memory as something unusual.

The objective of the current research was to determine if other factors, such as a feeling of isolation, novelty, or probability of the scenario happening, could explain the memory advantage seen in previous adaptive memory studies. Isolation seems to be a common difference between the grasslands survival scenario and other scenarios used for comparison (see Kostic et al., 2012). Previous research compared the grasslands survival scenario to other scenarios, such as the modern city survival scenario, in which there was a possible difference in terms of implied isolation. In the grasslands survival condition, you are presumably cut off from civilization, left to fend for yourself, and cannot contact anyone for help, whereas in the modern city survival scenario you are not alone and can

presumably contact other people for help. Novelty may be another factor that could be responsible for the memory advantage seen in the grasslands survival condition. The zombie scenarios employed by Soderstrom and McCabe (2011) seemed to be very novel and that might be why they elicited higher recall. Novelty can increase memory retention due to the lack of proactive interference and thus create better memory traces (Eysenck & Keane, 2010). When things have a lower probability of happening in the real world it might indicate that people have less experience with it. Lower probability of happening could indicate higher novelty. The grasslands survival scenario seems to be very unusual, improbable, and implies isolation so the adaptive memory effect might be due to these factors and not necessarily due to survival processing.

Two scenarios were created in an attempt to match the grasslands survival scenario in terms of novelty, familiarity, unusualness, isolation, and probability of happening in order to determine if the memory advantage seen in the grasslands survival condition would also apply to the novel conditions. One of the novel scenarios was a space mission scenario in which the participants imagined that they were on a solo space mission and that communication was lost to Earth. They would need to repair the communication with the tools on the spacecraft. The other novel scenario was an alien abduction scenario in which the participants imagined that they were abducted by aliens and were brought to the spacecraft alone. They would need to find ways to protect themselves from the aliens. To determine if these novel scenarios were in fact unusual, improbable, and isolated, the participants rated all of the conditions in terms of isolation, probability of happening, interest, imagery, emotionality, familiarity, and unusualness.

In the first study, participants rated unrelated words in terms of relevance in one of four conditions: grasslands survival, space mission, alien abduction, and moving. The moving condition served as a control as in other adaptive memory studies and was expected to produce the lowest recall. It was predicted that the two novel conditions and the grasslands survival condition would have similar levels of memory recall for rated words due to their expected similarity in terms of novelty, familiarity, unusualness, and probability of happening. Additionally, it was expected that the two novel scenarios and the grasslands survival scenario would be rated similarly in terms of isolation, probability of happening, interest, imagery, emotionality, familiarity, and unusualness.

In the second study, DRM word lists were used. Past research has found that no survival recall advantage was present when the accuracy scores were calculated (Howe & Derbish, 2010; Otgaar & Smeets, 2010). It was expected that the grasslands survival condition and the two novel conditions would have high true memory and high false memory. It was also predicted that the moving condition would have the lowest true and false memory due to previous research finding this result (Otgaar & Smeets).

The hypermnesic effect was investigated to see if the true and false recall would increase as the number of recall tests increased. It was predicted that all of the conditions would show a hypermnesic effect for true and false memories, but that the level of true and false recall would differ among the conditions. It was expected that the grasslands survival and two novel conditions would have a larger increase in true and false memory recall across tests compared to the moving condition. Past research conducted on levels of processing and false memory (Toglia et al., 1999) found that the participants in the semantic processing condition recalled significantly more studied words and more critical

lures than the nonsemantic (shallow processing) condition. Because the three scenarios are likely to induce deeper processing, it was predicted that the two novel conditions and grasslands survival condition would have higher true and false memory compared to the moving condition.

Experiment 1

Method

Participants

Students attending the University of North Florida (76 women and 20 men, mean age = 22.65 years, *SD* = 4.59 years) participated for extra credit. All of the participants were native English speakers.

Materials

The 32 unrelated stimulus words were drawn from Nairne et al. (2007, see Appendix A). The words were presented in 24 pt. Times New Roman bold font using DirectRT software on Dell Optiplex 330 and Dell Optiplex Sx 280 computers with 17-inch monitors. The participants rated the stimulus words in terms of relevance in one of the four conditions (see Appendix B for the complete scenarios). In the grasslands survival condition, the participants rated words in terms of relevance in a survival scenario. In this condition, the participants imagined that they were stranded in the grasslands of a foreign land and needed to find materials to survive. In the control condition (moving), participants imagined that they were moving to a foreign land and needed to rate the words in terms of relevance to this moving scenario. In the space mission condition, participants imagined that they were on a solo space mission and had

lost communication to earth and that the communication would need to be repaired. In the alien abduction condition, participants imagined that they were abducted by aliens and that they would need to find ways to protect themselves.

Each scenario was presented on the screen until the participant pressed the spacebar to move on to the next screen. Then the participants rated each of the words in terms of relevance to the scenario on a 5-point Likert scale with 1 indicating totally irrelevant and 5 indicating extremely relevant. Consistent with the majority of past research, each word was presented for 5 sec in the center of the screen. The word disappeared after 5 sec and then the 5-point Likert scale was displayed below where the word was initially displayed.

The scenario rating questionnaire was used to see potential differences and similarities among the characteristics of the scenarios which could explain the retention differences. In scenario rating questionnaire, participants were asked to rate the scenarios in terms of isolation, probability of happening, interest, imagery, emotionality, familiarity, and unusualness. Most of the items on the scenario rating questionnaire were derived from Nairne and Pandeirada (2010). New items created for the present experiments included the isolation and probability of happening items. Each item consisted of its own specific 5-point Likert scale. For example, in terms of the isolation item the participants were asked “how isolated would a person feel in this scenario?” and the 5-point Likert scale consisted of 1 being “not isolated at all” and 5 being “extremely isolated”.

Procedure

Before the participants arrived, they were randomly assigned to one of the four conditions. A between-subjects design was implemented. Up to three participants were tested at the same time. Barriers separated the participants from each other. All participants rated the same words presented in a different randomized order. The participants were told to rate relevance within 5 sec using the numbers 1 to 5 on the keyboard. Five practice words were presented before the actual rating task.

After the word rating task, the participants completed a distractor task in which they named as many of the United States as they could remember in 2 min. After the 2-min distractor task, the participants completed a pencil-and-paper incidental free recall memory test for 5 min. The participants were asked to write down as many words as they could remember from the word rating task on the computer. After the free recall task, the participants completed the scenario rating questionnaire.

Results

The purpose of this study was to determine if factors such as novelty, unusualness, isolation, and probability of happening could account for the adaptive memory advantage seen in the grasslands survival condition in previous research. Univariate analyses of variance (ANOVAs) were conducted on mean proportion correct, foil rate, and accuracy in order to test the hypothesis that the two novel conditions and the grasslands survival condition would have similar rates in memory recall. See Table 1 for means and standard deviations. All reported analyses are significant at $p < .05$ unless otherwise noted.

Mean Proportion Correct, Foil Rate, and Accuracy

The mean proportion correct was significantly different across the four scenarios, $F(3, 92) = 2.82$, $MSE = .02$, $\eta_p^2 = .08$. Post hoc tests conducted with Tukey's honestly significant difference test indicated that the mean proportion correct in the grasslands survival condition was significantly higher than the mean proportion correct in the moving condition ($t = 2.66$). These results replicate findings from prior research which indicated that the grasslands survival condition had a memory advantage over the moving condition (Nairne et al., 2007). There were no significant differences between the grasslands survival condition and the space mission and alien abduction conditions. These results showed that there was no memory advantage for the grasslands survival condition when comparing it to the two novel conditions. This indicated that there might not be something special about grasslands survival processing and that the adaptive memory advantage could be attributed to something other than ancestral survival as suggested by previous research (Nairne et al., 2007).

The next univariate ANOVA was conducted to test for differences in the foil (intrusion) rate among the four scenario conditions. Recalling an intrusion represents a false memory produced by a participant. The foil rate was significantly different across the four scenarios, $F(3,92) = 3.29$, $MSE = 2.32$, $\eta_p^2 = .10$. Post hoc tests conducted with Tukey's honestly significant difference test indicated that the foil rate in the grasslands survival condition was significantly less than the foil rate in the space mission condition ($t = 2.75$). The other comparisons were not significant. These results are inconsistent with prior research because Nairne et al. (2007) found that the grasslands survival condition

had the highest foil rate compared to the other conditions whereas the current research found that the grasslands survival condition had the lowest foil rate.

The next univariate ANOVA was conducted to test for differences in the accuracy which was calculated by dividing true memory by true memory plus false memory. The accuracy was significantly different across the four scenarios, $F(3,92) = 3.93$, $MSE = .01$, $\eta_p^2 = .11$. Post hoc tests conducted with Tukey's honestly significant difference test indicated that the accuracy in the grasslands survival condition was significantly higher than the accuracy in the moving and space mission conditions (all t's > 2.70). The alien and grasslands survival conditions were not significantly different from each other. The other comparisons were not statistically significant. These results indicated that the grasslands survival and alien conditions had the highest accuracy among all the conditions. The accuracy data is consistent with the proportion correct data. Participants in the grasslands survival condition had significantly higher accuracy, higher mean proportion correct, and lower foil rates compared to the moving condition.

Relevance Ratings

The next univariate ANOVA was conducted to test for the differences in the mean relevance rating for the rated words among the four scenario conditions. See Table 2 for means and standard deviations. Relevance ratings from two participants were not included in the analysis because of computer error. The relevance ratings were important because memory performance is affected by how congruent a word is to a task (Butler et al., 2009; Craik & Tulving, 1975). According to the levels of processing approach, memory performance would be better for words that were more congruent to a task than for words that were incongruent to a task (Craik & Tulving). Therefore, if more words

were rated as being relevant to a scenario, the memory recall for that scenario would most likely be higher. The mean relevance rating was significantly different across the four scenarios, $F(3,90) = 5.35$, $MSE = .29$, $\eta_p^2 = .15$. Post hoc tests conducted with Tukey's honestly significant difference test indicated that the mean relevance ratings in the space mission and alien abduction conditions were significantly lower than the mean relevance ratings in the grasslands survival condition. The other comparisons were not statistically significant. Thus, the relevance rating data were not consistent with the recall findings, which rules out that the words were congruent with the scenarios.

Scenario Rating Questionnaire

The purpose of the scenario rating questionnaire was to see if the two novel scenarios matched the grasslands survival scenario in terms of novelty, familiarity, unusualness, isolation, and probability of happening. A univariate ANOVA was conducted on each item in the scenario rating questionnaire in order to test for differences in the ratings among the four scenario conditions. See Table 3 for means and standard deviations.

High familiarity ratings could indicate that the scenario was novel which could then lead to high rates in memory retention. There was a significant main effect of familiarity across the four scenarios, $F(3, 92) = 2.76$, $MSE = 1.21$, $\eta_p^2 = .08$. A Tukey honestly significant difference test indicated that the alien abduction condition was rated as significantly less familiar than the grasslands survival condition ($t = 2.62$). The other comparisons were not significant. Familiarity ratings do not appear to explain the differences in rates in memory retention because the conditions with the two highest rates

of memory recall (grasslands survival and alien abduction) had dissimilar familiarity ratings.

Unusualness ratings could also indicate how novel a scenario would be which could increase memory retention. There was a significant main effect of unusualness across the four scenarios, $F(3, 92) = 5.12$, $MSE = 1.24$, $\eta_p^2 = .14$. A Tukey honestly significant difference test indicated that the moving condition was rated as significantly less unusual than the alien abduction condition ($t = 3.88$). The other comparisons were not significant. The unusualness ratings might explain the higher recall seen in the grasslands survival, alien abduction, and space mission conditions. The grasslands survival, alien abduction, and space mission conditions had higher mean unusualness ratings compared to the moving condition which is consistent with the recall data.

For isolation, there was a significant main effect across the four scenarios, $F(3, 92) = 24.75$, $MSE = .92$, $\eta_p^2 = .45$. A Tukey honestly significant difference test indicated that the moving condition was rated as significantly less isolating than the other three conditions (all t's > 6.63). The grasslands survival, space mission, and alien abduction condition did not significantly differ from each other. These results showed that the feeling of isolation might be a possible explanation for why the grasslands survival, space mission, and alien abduction conditions had similar rates in memory recall. A sense of isolation might induce memory retention seen in the grasslands survival scenario and two novel conditions. It is adaptive for humans to be in groups so isolation might stand out, which could in turn increase memory retention.

For probability of happening, there was a significant main effect across the four scenarios, $F(3, 92) = 26.75$, $MSE = .85$, $\eta_p^2 = .47$. A Tukey honestly significant

difference test indicated that the alien abduction condition was rated as significantly less probable than the space mission, grasslands survival, and moving conditions (all *t*'s > 4.40). The moving condition was rated as significantly more probable than the other three conditions (all *t*'s > 4.25). The probability of happening rating does not appear to explain the memory recall seen in the alien abduction condition. The grasslands survival and space mission conditions were rated as less probable than the alien abduction condition yet the memory recall for all of the conditions were not significantly different each other. There were no significant differences between the conditions for interest, imagery, and emotionality. These findings are consistent with prior research in which the grasslands survival condition was not rated as significantly different to the modern city survival condition (Nairne & Pandeirada, 2010).

In Experiment 1, there was the typical adaptive memory effect in which the grasslands survival condition had significantly higher recall compared to the moving condition. Additionally, the grasslands survival and novel scenarios had similar rates in memory recall. The similarity in memory recall could be due to the similarity in unusualness and isolation ratings. Experiment 2 was conducted in order to further explore the grasslands survival and novel scenarios in the context of the DRM and hypermnesia paradigms.

Experiment 2

Method

Participants

Students attending the University of North Florida (75 women and 21 men, mean age = 22.63 years, *SD* = 6.86 years) participated for extra credit. All of the participants were native English speakers.

Materials

The participants were presented with six DRM word lists of 10 words each (see Appendix C). As is commonly done in DRM studies, the words in each list were presented in order of strongest to weakest associate (Roediger & McDermott, 1995). The six DRM lists that lead to the highest levels of false recall were selected (Stadler, Roediger, & McDermott, 1999). The words were presented in 24 pt. Times New Roman bold font using DirectRT software on Dell Optiplex 330 computers with 17-inch monitors. The words were presented the same way as in Experiment 1. The scenarios and the scenario rating questionnaire were the same as those used in Experiment 1.

Procedure

A mixed-factorial design was implemented with the scenario conditions as the between-subjects factor and the three recall tests as the within-subjects factor. The procedure for this experiment was the same as Experiment 1 with the following exceptions. The participants were presented with 60 words instead of 32 words. These 60 words consisted of six DRM lists of 10 words each. A random order of the six DRM lists

was constructed. All participants were presented with the word lists in that same random order. Also, instead of having one 5-min free recall test, three successive 5-min free recall tests were conducted. During the first memory test, the participants were given 5 min to recall words from the list in any order. During the second and third memory tests, the participants were given 5 min to write down all of the words they remembered from the previous memory tests as well as any other new words they could remember from the word list. During each memory test, participants were given a warning when there was 1 min remaining in order to motivate the participants to think of new words. Upon completion of the third recall test, participants completed the scenario rating questionnaire.

Results

The first purpose of this study was to determine if the two novel conditions and the grasslands survival condition would have similar rates in memory recall, replicating the findings from Experiment 1. The second purpose of this study was to determine if participants in the grasslands survival and two novel conditions would show a larger increase in true and false memory recall across tests compared to the moving condition. Four mixed-factorial design ANOVAs on mean proportion correct, mean proportion of critical lures, foil rate, and accuracy were conducted in order to test the hypothesis that the two novel conditions and the grasslands survival condition would have similar rates in true and false memory across the recall tests. The mixed-factorial design ANOVAs implemented a 4 (Condition: grasslands survival, space mission, alien abduction, or moving) by 3 (Recall tests: test 1 vs. test 2 vs. test 3) design with repeated-measures on the second factor. All reported analyses are significant at $p < .05$ unless otherwise noted.

Mean Proportion Correct

A mixed-factorial ANOVA was conducted to test for differences in the mean proportion correct among the four scenario conditions across the recall tests. See Table 4 for means and standard deviations. There was a significant main effect of recall test, $F(2,184) = 10.16$, $MSE = .00$, $\eta_p^2 = .10$. Pairwise comparisons of recall test using the Least Significant Difference correction indicated that test 3 had a significantly higher mean proportion correct compared to test 1 and test 2 (all t's > 3.67). No other comparisons were significant. There were no differences in the between-subjects effect of condition. The grasslands survival condition did not have a higher mean proportion correct compared to the other conditions which indicates that the adaptive memory effect was not present. However, the interaction between recall tests and condition was significant, $F(6,184) = 2.65$, $MSE = .00$, $\eta_p^2 = .08$.

To further explore the interaction, a repeated measures ANOVA was conducted on each condition. In the grasslands survival and moving conditions, there was no significant main effect of test. This indicated that the grasslands survival and moving conditions did not experience the hypermnesic effect.

In the space mission condition, there was a significant main effect of test, $F(2,46) = 9.69$, $MSE = .00$, $\eta_p^2 = .30$. Pairwise comparisons indicated that test 2 and test 3 had a significantly higher mean proportion correct compared to test 1 (all t's > 2.54). There were no other statistically significant comparisons. This indicated that in the space mission condition there was evidence of a hypermnesic effect.

In the alien abduction condition, there was a significant main effect of test, $F(2,46) = 4.22$, $MSE = .00$, $\eta_p^2 = .16$. Pairwise comparisons indicated that test 3 had a

significantly higher mean proportion correct compared to test 2 (t = 2.78). No other comparisons were statistically significant. Although test 3 did not have significantly higher recall compared to test 1, the increase in recall from test 1 to test 3 indicated that in the alien abduction condition there was evidence of a hypermnesic effect. It is interesting that the novel conditions showed evidence of a hypermnesic effect for target words whereas the grasslands survival and moving conditions did not. A possible explanation for why the grasslands survival and moving conditions did not experience the hypermnesic effect is discussed later.

Mean Proportion of Critical Lures

A mixed-factorial ANOVA was conducted to test for differences in the mean proportion of critical lures among the four scenario conditions across the recall tests. See Table 5 for means and standard deviations. There was a significant main effect of recall test, $F(2,184) = 12.93$, $MSE = .02$, $\eta_p^2 = .12$. Pairwise comparisons of recall test indicated that test 3 and test 2 had a significantly higher mean proportion of critical lures compared to test 1 (all t's > 3.90). The other comparisons were not significant. This indicated there was a hypermnesia effect for false memories across recall tests which is consistent with Payne et al. (1996). There were no differences in the between-subjects effect of condition. This indicated that the mean proportion of critical lures did not significantly differ among the conditions. The interaction between recall tests and condition was not significant. These findings are inconsistent with previous research that found that significantly more critical lures were recalled in the grasslands survival condition compared to the moving and pleasantness conditions (Howe & Derbish, 2010; Otgaar & Smeets, 2010).

Foil Rates

A mixed-factorial ANOVA was conducted to test for differences in the foil rates among the four scenario conditions across the recall tests. See Table 6 for means and standard deviations. There was a significant main effect of recall test, $F(2,184) = 10.49$, $MSE = 5.09$, $\eta_p^2 = .10$. Pairwise comparisons of recall test indicated that test 3 had significantly higher foil rates compared to test 1 and test 2 (all *t*'s > 3.22). Pairwise comparisons of recall test also showed that performance on test 2 revealed significantly higher foil rates compared to test 1 ($t = 2.55$), indicating that foil rates increased across recall tests. The main effect of condition and the interaction were not significant. Previous research found that the grasslands survival condition produced more foil rates compared to the moving and pleasantness conditions (Howe & Derbish, 2010; Otgaar & Smeets, 2010). The current findings are inconsistent with this past research.

Accuracy

A mixed-factorial ANOVA was conducted to test for differences in the accuracy among the four scenario conditions across the recall tests. The accuracy was calculated by dividing the rate of true memories by the combined rates of true memories, false memories, and critical lures (see Howe & Derbish, 2010). See Table 7 for means and standard deviations. There was a significant main effect of recall test, $F(2,184) = 17.31$, $MSE = .00$, $\eta_p^2 = .16$. Pairwise comparisons of recall test indicated that test 3 and test 2 had significantly lower accuracy compared to test 1 (all *t*'s > 4.22). No other comparisons were significant. Accuracy was lower due to the increased foil rates and mean proportion of critical lures across recall tests. The main effect of condition and the interaction were not significant. When previous research compared the accuracy in the grasslands survival

condition compared to the moving and pleasantness conditions, no survival recall advantage was found (Howe & Derbish, 2010; Otgaar & Smeets, 2010). The current findings are consistent with this past research.

Relevance Ratings

A univariate ANOVA was conducted to test for the differences in the mean relevance rating for the rated words among the four scenario conditions. See Table 8 for means and standard deviations. Relevance ratings from two participants were not included in the analysis because of computer error. The mean relevance rating was marginally significant across the four scenarios, $F(3,90) = 2.40$, $MSE = .33$, $\eta_p^2 = .07$, $p < .07$. The higher mean relevance ratings in the grasslands survival and moving conditions could account for the nonexistent hypermnesic effect across the recall tests for these conditions. The recall for the grasslands survival and moving conditions started out higher than the novel conditions for test 1 and remained consistent across tests. The mean proportion correct in the recall tests in the novel scenarios started out lower, but gradually increased to the same mean proportion correct as the grasslands survival and moving scenarios in test 3.

Scenario Rating Questionnaire

The purpose of the scenario rating questionnaire items was to determine if the two novel scenarios matched the grasslands survival scenario in terms of novelty, familiarity, unusualness, isolation, and probability of happening. A univariate ANOVA was conducted on each item in the scenario rating questionnaire. See Table 9 for means and standard deviations.

For unusualness, there was a significant main effect across the four scenarios, $F(3, 92) = 10.19$, $MSE = 1.43$, $\eta_p^2 = .25$. A Tukey honestly significant difference test indicated that the moving condition was rated as significantly less unusual than the alien abduction and grasslands survival condition (all *t*'s > 3.01). The other comparisons were not significant. This finding replicated what was found in Experiment 1, but now the grasslands survival condition was also rated as significantly more unusual than the moving condition. This could indicate that the grasslands survival and novel conditions are considered novel and unusual.

For isolation, there was a significant main effect across the four scenarios, $F(3, 92) = 26.92$, $MSE = .64$, $\eta_p^2 = .48$. A Tukey honestly significant difference test indicated that the moving condition was rated as significantly less isolating than the other three conditions (all *t*'s > 6.15). This finding was consistent with the results found in Experiment 1. The grasslands survival, space mission, and alien abduction condition did not significantly differ from each other. This would indicate that the grasslands survival and novel conditions are considered isolated scenarios.

For probability, there was a significant main effect across the four scenarios, $F(3, 92) = 45.45$, $MSE = .82$, $\eta_p^2 = .60$. A Tukey honestly significant difference test indicated that the alien abduction condition was rated as significantly less probable than the other conditions (all *t*'s > 4.96). The moving condition was rated as significantly more probable than the other three conditions (all *t*'s > 4.65). These results replicate the findings from Experiment 1 in which the grasslands survival and novel conditions were rated as less probable which could imply novelty. There were no significant differences between the conditions for the rest of the items.

Discussion

The purpose of the present research was to investigate whether other factors such as a feeling of isolation or novelty could explain the adaptive memory advantage observed in previous adaptive memory research (e.g., Nairne et al., 2007; Nairne et al., 2008; Nairne & Pandeirada, 2010; Weinstein et al., 2008). In Experiment 1, it was found that the grasslands survival and novel scenarios had similar rates in memory recall. This finding was consistent with the hypotheses that the grasslands survival and novel conditions would not significantly differ in terms of recall. The typical adaptive memory effect in recall was found in the grasslands survival and moving conditions. Additionally, it is noteworthy that the same stimuli from Narine et al. (2007) were used yet the grasslands survival and novel conditions still did not significantly differ from each other. In Experiment 2, it was found that the memory recall was similar across the four scenarios indicating that there was no memory advantage for the grasslands survival scenario. The findings in the present research are not consistent with past research. Past adaptive memory research has found that participants in the grasslands survival scenario outperformed participants in many other scenarios thought to produce deep levels of processing (Nairne et al. 2007; Nairne et al. 2008; Nairne & Pandeirada; Weinstein et al.).

In the current research, when participants rated the scenarios in terms of DRM lists, no typical survival advantage effect was found. The true memory recall was similar across the four scenarios. Past research had found that the grasslands survival scenario always outperformed the moving scenario in terms of memory recall (Nairne et al. 2007; Weinstein et al., 2008, Butler et al., 2009) yet this was not found in the present research.

There is a possibility that the materials in Experiment 2 affected the memory recall for the conditions because the word list was longer than in typical adaptive memory experiments. The list consisted of 60 words so it is possible that the participants were not able to sustain their attention throughout the whole word presentation. Additionally, all of the scenarios had similar rates of critical lures. These findings are inconsistent with previous research that found that the grasslands survival scenario had higher false memories and had higher true recall compared to the moving scenario (Otgaar & Smeets, 2010). In terms of the hypermnesic effect, the novel scenarios experienced hypermnesia whereas the grasslands survival and moving scenarios did not. For the grasslands survival and moving scenarios, the recall started out high for test 1 and remained consistent across tests. The mean proportion correct in the recall tests in the novel scenarios started out lower, but gradually increased to the same mean proportion correct as the grasslands survival and moving scenarios.

In both experiments, there was a clear pattern in the scenario rating questionnaire that indicated that the grasslands survival and novel scenarios were rated as significantly more isolated than the moving scenario. In Experiment 1, a feeling of isolation might explain the similarity in recall observed in the grasslands survival and novel conditions. Additionally, both experiments indicated that the grasslands survival and novel scenarios were rated as more unusual than the moving scenario. This could indicate that these scenarios were more unusual and novel than the moving scenario. Novelty might also be able to explain the memory recall advantage seen in the grasslands survival and two novel scenarios in Experiment 1.

Previous research has found that survival scenarios, regardless of isolated or group contexts, showed an adaptive memory advantage (Kostic et al., 2012). In a within-subject design experiment, participants processed words in an isolated lost at sea scenario, a group lost at sea scenario, and a pleasantness scenario. In another within-subjects experiment, participants processed words in a ghost town scenario, city scenario, and a pleasantness scenario. The results indicated that the isolated and group scenarios did not significantly differ from each other in terms of recall. These researchers concluded that a feeling of isolation could not explain the memory advantage seen in the grasslands survival scenario (Kostic et al.). However, there are key differences between this research and the present research. First, the original grasslands survival scenario and a group grasslands survival scenario were not used for comparison in any of the experiments. It seems logical to use these scenarios in order to directly test whether the isolation in the original grasslands survival is attributing to the memory advantage that is typically seen. Additionally, they implemented a within-subjects design whereas the present research implemented a between-subjects design. The differences in the scenarios may not seem so extreme to a participant when just comparing an isolated scenario to a group scenario while the setting remains constant. Lastly, the researchers used scenarios with implied isolation and did not actually ask the participants to rate the scenarios in terms of isolation whereas this was the case in the present research. There is no way of knowing how isolated these general survival scenarios would be rated in comparison to the original grasslands survival scenario. In the original grasslands survival scenario you are completely cut off from other people whereas in the ghost town scenario you could presumably contact someone from a payphone or find help in a town close by. In the

novel scenarios created for these experiments you would not be able to contact anyone for help.

There is also a possibility that the novel scenarios might have induced survival processing in general. Previous research has found that survival scenarios in general, regardless of ancestral contexts, showed a memory advantage (Kostic et al., 2012; Soderstrom & McCabe, 2011). These researchers used different survival scenarios such as a desert scenario, lost at sea scenario, jungle scenario, and a lost in space scenario, which all had similar rates in recall to the original grasslands survival scenario. They concluded that survival processing is not contingent on the use of ancestral contexts, but can be generalized to other survival scenarios. Our ancestors would have never experienced an alien abduction or a space mission so it is logical to assume that these scenarios did not induce ancestral survival processing. This could indicate that the novel scenarios might have induced survival processing in general.

Although it is still unclear what factors caused the similar rates in memory recall in the grasslands survival and novel scenarios, it is still noteworthy to find that the grasslands survival scenario is not the most superior approach to memory retention as suggested by Nairne et al. (2007). Further research is still needed to identify whether novelty or a feeling of isolation could explain the memory advantage observed in the novel and grasslands survival scenarios in the first experiment. It is possible that being in groups was essential and adaptive for survival in the past so the apparent isolation in these scenarios is noteworthy and stands out to a person. Additionally, the novelty of the scenarios could be attention-grabbing and thus could increase the remembrance for items. It also seems plausible that memory distinctiveness (see Schacter, Israel, & Racine, 1999)

could play a role in the recall observed in the present research. These researchers found that pictures are more distinctive and thus reduced false recognition (Schacter et al., 1999). In Experiment 1 of the present research, the grasslands survival and the alien abduction conditions produced lower foil rates and higher accuracy. It seems plausible that these conditions were more distinctive compared to the other conditions which could explain the lower false memory observed in these conditions.

Past research has investigated memory distinctiveness in relation to adaptive memory (Kroneisen & Erdfelder, 2011). According to the levels of processing approach, richness and distinctiveness of encoding influences memory recall (Craik & Tulving, 1975). Therefore, complex sentences compared to simple sentences provide more opportunities for elaboration and create more unique associations. Past research has found that when the original grasslands survival scenario was compared to a modified grasslands survival scenario containing only one survival problem (potable water), the survival advantage disappeared for the modified scenario (Kroneisen & Erdfelder). They concluded that it was not adaptive memory, but memory distinctiveness creating the advantage observed in the grasslands survival scenario. It is possible that the novel scenarios, specifically the alien abduction scenario, in the present research could cause more elaboration and distinctiveness of encoding which could lead to higher recall. Future research should investigate these issues further.

Appendix A: Stimuli for Experiment 1

truck	juice	silver	door	car
diesel	shoes	orange	broccoli	sword
mountain	finger	whiskey	bear	apartment
pepper	aunt	flute	cathedral	soccer
book	chair	snow	screwdriver	emerald
carbon	catfish	silk	teacher	pan
sock	eagle			

Appendix B: Scenarios

Grasslands Survival Scenario: "In this task, we would like you to imagine that you are stranded in the grasslands of a foreign land, without any basic survival materials. Over the next few months, you'll need to find steady supplies of food and water and protect yourself from predators. We are going to show you a list of words, and we would like you to rate how relevant each of these words would be for you in this survival situation. Some of the words may be relevant and others may not—it's up to you to decide" (Nairne, Thompson & Pandeirada, 2007, p. 264).

Moving Scenario: "In this task, we would like you to imagine that you are planning to move to a new home in a foreign land. Over the next few months, you'll need to locate and purchase a new home and transport your belongings. We are going to show you a list of words, and we would like you to rate how relevant each of these words would be for you in accomplishing this task. Some of the words may be relevant and others may not—it's up to you to decide". (Nairne, Thompson & Pandeirada, 2007, p. 264).

Space Mission Scenario: "In this task, we would like you to imagine that you are on a solo space mission and that communication was lost to mission control on Earth. You'll need to repair the communication to Earth with the tools you have on your spacecraft. We are going to show you a list of words, and we would like you to rate how relevant each of these words would be for you in this situation. Some of the words may be relevant and others may not—it's up to you to decide".

Alien Abduction Scenario: "In this task, we would like you to imagine that you are abducted by alien beings and you are brought to their spacecraft alone. While you are there, you'll need to find ways to protect yourself from the alien beings. We are going to show you a list of words, and we would like you to rate how relevant each of these words would be for you in this situation. Some of the words may be relevant and others may not—it's up to you to decide".

Appendix C: Stimuli for Experiment 2

WINDOW, door, glass, pane, shade, ledge, sill, house, open, curtain, frame

SLEEP, bed, rest, awake, tired, dream, wake, snooze, blanket, doze, slumber

SMELL, nose, breathe, sniff, aroma, hear, see, nostril, whiff, scent, reek

DOCTOR, nurse, sick, lawyer, medicine, health, hospital, dentist, physician, ill, patient

SWEET, sour, candy, sugar, bitter, good, taste, tooth, nice, honey, soda

CHAIR, table, sit, legs, seat, couch, desk, recliner, sofa, wood, cushion

Note. Lure words are in italics.

Table 1

Means of Proportion Correct Recall, Means of Foils, and Accuracy in Experiment 1

	Survival	Space	Alien	Moving
Proportion	.44 (.12)	.36 (.15)	.39 (.11)	.35 (.13)
Foils	.29 (.69)	1.50 (2.21)	.58 (1.06)	1.25 (1.68)
Accuracy	.98 (.06)	.89 (.13)	.96 (.08)	.90 (.13)

Note. Standard deviations are presented in parentheses.

Table 2

Mean Relevance Ratings of Words in Experiment 1

	Survival	Space	Alien	Moving
Relevance	2.80 (.52)	2.20 (.57)	2.36 (.48)	2.45 (.57)

Note: Standard deviations are presented in parentheses

Table 3

Mean of Scenario Ratings in Experiment 1

	Survival	Space	Alien	Moving
Interesting	3.33 (.96)	3.46 (.83)	3.54 (.78)	3.04 (1.04)
Image	4.08 (.88)	3.92 (1.18)	4.17 (.87)	3.92 (1.02)
Emotion	2.33 (.96)	2.50 (.89)	2.42 (.97)	2.46 (1.18)
Familiar	3.29 (.81)	2.83 (1.24)	2.46 (.98)	3.17 (1.31)
Unusual	2.83 (1.05)	3.00 (1.02)	3.54 (1.29)	2.29 (1.08)
Isolated	4.33 (.92)	4.52 (.88)	4.29 (.96)	2.46 (1.06)
Probability	2.63 (.82)	2.54 (1.02)	1.38 (.58)	3.75 (1.15)

Note. Standard deviations are presented in parentheses.

Table 4

Mean Proportion Correct across Recall Tests in Experiment 2

	Test 1	Test 2	Test 3
Survival	.41 (.13)	.41 (.12)	.42 (.12)
Space Mission	.36 (.10)	.39 (.11)	.41 (.12)
Alien Abduction	.36 (.11)	.34 (.14)	.39 (.13)
Moving	.40 (.10)	.41 (.13)	.41 (.12)

Note. Standard deviations are presented in parentheses.

Table 5

Mean Proportion of Critical Lures across Recall Tests in Experiment 2

	Test 1	Test 2	Test 3
Survival	.30 (.21)	.42 (.24)	.42 (.23)
Space Mission	.38 (.22)	.44 (.23)	.49 (.21)
Alien Abduction	.35 (.20)	.45 (.29)	.45 (.26)
Moving	.35 (.26)	.43 (.25)	.35 (.22)

Note. Standard deviations are presented in parentheses.

Table 6

Foil Rates across Recall Tests in Experiment 2

	Test 1	Test 2	Test 3
Survival	1.38 (1.58)	1.79 (2.17)	1.88 (2.05)
Space Mission	1.83 (2.70)	2.33 (2.46)	3.29 (4.11)
Alien Abduction	1.21 (1.35)	1.83 (1.93)	2.71 (3.01)
Moving	1.63 (1.77)	3.25 (5.60)	4.13 (7.71)

Note. Standard deviations are presented in parentheses.

Table 7

Accuracy across Recall Tests in Experiment 2

	Test 1	Test 2	Test 3
Survival	.89 (.08)	.85 (.08)	.85 (.08)
Space Mission	.84 (.10)	.83 (.09)	.80 (.10)
Alien Abduction	.87 (.07)	.81 (.12)	.81 (.11)
Moving	.87 (.09)	.82 (.13)	.82 (.15)

Note. Standard deviations are presented in parentheses.

Table 8

Mean Relevance Ratings in Experiment 2

	Survival	Space	Alien	Moving
Relevance	2.79 (.58)	2.56 (.58)	2.40 (.60)	2.75 (.54)

Note. Standard deviations are presented in parentheses.

Table 9

Mean of Scenario Ratings in Experiment 2

	Survival	Space	Alien	Moving
Interesting	3.17 (.96)	2.96 (.86)	3.46 (1.14)	3.29 (.96)
Image	4.21 (.88)	4.04 (1.00)	3.96 (1.04)	3.79 (.88)
Emotion	2.63 (.88)	2.50 (1.29)	2.21 (1.22)	2.54 (1.06)
Familiar	2.88 (1.19)	2.79 (1.29)	2.50 (1.38)	3.12 (1.39)
Unusual	3.17 (1.40)	2.83 (1.20)	4.00 (1.10)	2.13 (1.04)
Isolated	4.96 (.20)	4.42 (.83)	4.50 (.83)	3.00 (1.06)
Probability	2.42 (1.18)	2.92 (1.02)	1.13 (.34)	4.13 (.85)

Note. Standard deviations are presented in parentheses.

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